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In ancient Egyptian tomb-paintings (WILKINSON'S *Ancient Egyptians*, i. p. 351), archers are depicted wearing such wrist-guards; and in the European museums it is quite common to find small, oblong, thin plates of bone or ivory, pierced with holes, which are universally regarded there as having been employed for such a purpose.

HENRY W. HAYNES.

Boston, Feb. 29.

#### Notes on the Geology of the Cascade Range.

IN *Science* of Feb. 10, Mr. Herbert Lang discussed evidence bearing on the history of the Cascade Range in Oregon. It may be of interest in connection with Mr. Lang's conclusions to state some facts observed by the parties of the Northern Transcontinental Survey in explorations conducted in Washington Territory from 1881 to 1884.

Coal was the prime object of these surveys, and work was most thorough where it was found in greatest abundance; but the prospecting parties covered the greater part of the Cascade Range north of Mount Rainier, and the facts which follow are of my own observation unless otherwise stated.

It was found that the formations of the Cascade Range in Washington Territory are, 1. Glacial drift; 2. Tertiary eruptives; 3. Unaltered sandstones and shales containing numerous carbonaceous beds, thickness  $13,000' \pm$  (Laramie?); 4. Local conglomerates (cretaceous?); 5. Altered sediments; 6. Granite.

The granite base of this column was observed beneath the eruptives of Mount Rainier by Mr. S. F. Emmons in September, 1870; it crops out extensively on Upper Cedar River, a stream which enters Puget Sound at Seattle; it forms the heights of the Peshastan Range, north of Ellensburg; granite cliffs of the western side of the Columbia Cañon oppose basaltic walls of the eastern bank from the mouth of the Methow River to the Wenatchie, and granite forms the mass of the Cascade Range north of the Snoqualmie Pass. In remarks recently made before the Philosophical Society of Washington, Dr. George M. Dawson described the continuation of this granite backbone northward for nine hundred miles, and he dwelt upon the absence of volcanic rocks north of the 49th parallel.

The altered sediments which rest upon the granite have yielded no fossils by which their age might be guessed, but they resemble rocks assigned to the paleozoic age by the Canadian survey, and may be of the same horizons. The beds consist of crystalline schists, limestone, and quartzite. They occur throughout the Cascade Range, from latitude  $46^{\circ}$  northward, and in the Olympic Mountains. Gold has been found in the crest east of Mount Rainier, in gravels derived from the Olympic mass, and on Ruby Creek, a tributary of the Skagit River. Magnetic iron ore occurs in the formation near Snoqualmie Pass, and hard blue specular ore occurs in association with jasper on the Skagit River. This ore and its associations very closely resemble the specular ores of Lake Superior, but they probably belong to a very different period of geologic history. Limestone and schist traversed by quartz veins form an extensive area south and west of Mount Baker, bounded on the north by coal-bearing sandstones.

The altered sediments underlie later unaltered deposits, probably unconformably; but no contact has been sufficiently well observed to determine a definite relation. A conglomerate containing agatized casts of baculites (?) was observed by an intelligent prospector on Skookum-chuck Creek, south-east of New Tacoma; another conglomerate was seen by myself in the Peshastan Range (it consisted of large granite and quartz pebbles, resting on granite, and was several hundred feet thick); and at the coal-mine on the Skagit River, sandstone dipping  $40^{\circ}$  south-west rests upon iron ore bearing schists dipping  $35^{\circ}$  south.

These three instances are the only ones known to me in which the apparent base of the recent sedimentary beds has been seen. They mark the beginning of a profound subsidence during which accumulations of sand and clay appear to have kept pace with the sinking surface. In the Wilkeson Coal-Field the thickness of these beds probably reaches  $13,000' \pm$  feet, with 127 coal-beds, ranging from one to forty feet in thickness. This deposit is shown by its fossils to be of fresh or brackish water origin. Unfortunately no large collections were made, and the fossils do not definitely determine the age of the coal-measures; but Prof. J. S. Newberry and

Dr. C. A. White agree in considering them the probable equivalent of the Laramie.

These recent sediments occur throughout the Puget Sound basin, they rim the Olympic mass, they have been found in the high crest of the Cascades near Cowlitz Pass, and north of Natchez Pass, and they were deposited to a thickness of about 1,000 feet in the region now drained by the Upper Yakima and Wenatchie Rivers. The great thickness and wide distribution of this formation are unusual features of a fresh-water deposit, and it is difficult to conceive the conditions which maintained fresh water over the area of such a subsidence. But the problem is somewhat simplified when it is recognized that the region was an archipelago like that so recently studied in southern Oregon by Captain Dutton and Mr. Diller. The Olympic peninsula was then an island, and the continuity of the coal-measure series may well be interrupted by similar spaces not yet traced out.

This formation was checked by compression, which resulted in folds of an Appalachian type having a nearly north and south trend. The closeness of flexure varies in different areas, and the chemical concentration of the coal is proportionate to the mechanical disturbance. The extreme of uniform alteration over an area of fifty square miles was reached in the Wilkeson coking coal; but local alteration, due to later volcanic influences, frequently went much further.

This compression closed the history of sedimentary deposits in this region. It may be assumed that it took place at the same period as the elevation of the northern portion of the Cascade Range, assigned by Dr. Dawson to post-cretaceous time; but we may not yet date the uplift more definitely.

A period of erosion intervened between the uplift and the outpouring of eruptives. Mounts Hood, St. Helens, Adams, and Rainier are the conspicuous peaks of the locus of maximum volcanic activity across which the Columbia has cut its cañon. Mount Baker is the northern outlier of the line of volcanoes which begins with Shasta and Lassens Peak.

Mr. Lang's hypotheses are in part confirmed by the facts stated; but like forces have produced unlike results in California and in Washington Territory. South of latitude  $42^{\circ} 30'$  the Cascade's volcanic mass is supported on a slightly disturbed sedimentary base: north of latitude  $46^{\circ} 30'$  the range of closely flexed sediments is dotted with volcanic cones. The difference is one of degree, not of kind; but the difference is great.

Many of the facts condensed in this note are stated, with more detailed descriptions of the coal-measures, in a report on the coals of Washington Territory, in Vol. XV., 'Tenth Census Reports.'

BAILEY WILLIS.

Washington, D.C., March 1.

#### Answers.

21. GLOBULAR LIGHTNING.—The late Prof. John Fries Frazer has frequently mentioned to me having seen in his youth a ball of fire descend and strike a tree in a field in front of him. Of course, this phenomenon happened during a thunder-storm. The distance from the object struck was about fifty yards or less. P. F.

Philadelphia, Penn., March 2.

22. WASP-STINGS.—The discussion going on in your columns at the present time in regard to wasp-stings recalls a curious discovery of my boyhood. I was a very ticklish youngster, and my comrades sometimes used that weakness for their own amusement. One boy used to show me how little effect tickling had upon him; but one hot summer day, as he was lying reading, I tickled him on the ribs, and he almost went into convulsions. I found that he was far more sensitive than any boy in the company, and he revealed his secret to me under condition of my never telling any one else. By holding his breath he became pachydermatous, and would let anybody tickle him as much as they pleased; but of course they always gave it up at once when they saw his stolid look. I tried the plan, and it worked admirably; and it is my only protection, even unto this day, for my cuticle is as sensitive as ever. The deduction is simple: a man holds his breath,—and a wasp,—and the stinger is 'bluffed.' *Verb. sap.*

R. McMILLAN.

Liverpool, Eng., Feb. 21.